HOUSE OF COMMONS SESSION 1992–93

SCIENCE AND TECHNOLOGY COMMITTEE

THE ROUTES THROUGH WHICH THE SCIENCE BASE IS TRANSLATED INTO INNOVATIVE AND COMPETITIVE TECHNOLOGY

MINUTES OF EVIDENCE

Wednesday 9 June 1993

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of the Department for Education

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Members present:

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Mr Spencer Batiste
Dr Jeremy Bray
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Lynne Jones
Mr Andrew Miller
Sir Trevor Skeet
Mr Alan W Williams

Memorandum from the Department for Education (May 1993)

INTRODUCTION

1. This memorandum is intended to contribute to the Committee's current inquiry into the routes through which the Science Base is translated into innovative and competitive industry.

2. In preparation for the session on 9 June, at which Departmental officials [and representatives of OFSTED] are to give oral evidence, it offers in Section A, a brief resumé of relevant educational policies, programmes and practice in the compulsory school and further education systems in England, and in Section B, answers to specific questions from the Committee.

3. This memorandum does not touch on higher education (that is undergraduate, postgraduate or professional continuing education) about which the Committee has already received information in a different context, and which will also be covered in the Government's forthcoming Science and Technology White Paper. Nor does it cover in detail programmes, such as the technical and vocational education initiative (TVEI) which are primarily the responsibility of another Department, in this case the Department of Employment, whom we understand to be giving evidence separately. Material on inter-departmental matters has been agreed with the Departments concerned.

SECTION A: POLICY, PROGRAMMES AND PRACTICE 5-19

I. *Policy*

4. The Government's educational policies over the past decade, including the introduction of the National Curriculum, have been designed to improve significantly the quality and standard of learning and its relevance to the needs of industry, and to update it to take account of developments in the knowledge base, whether through academic or industrial innovation, so as to facilitate economic growth and to ensure that we can compete effectively in not only European but also world-wide markets.[1] More recently, policies have focused on developing diversity among schools as a means of offering parents the maximum choice, and on achieving the National Education and Training Targets in respect of the foundation learning targets for young people. These include by 1997, 80 per cent of 18-year-olds to reach National Vocational Qualifications (NVQ) level 2 (or broadly 4 or 5 good GCSEs), and by 2000, 50 per cent of 18-year-olds to reach NVQ level 3 (or broadly 2 A levels or AS equivalent).[2]

5. In particular, policies have focused on:

(a) *In Compulsory Education for all 5- to 16-Year-Olds*

- The introduction of the National Curriculum—a broad and balanced, basic, preparatory education in the skills, knowledge and understanding fundamental to any further education or training.
- The assessment of achievement against National Curriculum requirements and its widespread reporting not only to parents but to the community, including industry.
- Some flexibility at 14 to permit academic or vocational specialisation in the light of pupils' aptitudes and aspirations.
- The inclusion for the *first* time, for all, both a comprehensive study of science, and of technology.
- Support for the development of schools which choose to go beyond the basic, compulsory National Curriculum to specialise in particular subject areas, especially technology and science.
- An adequate supply of appropriately trained teachers.
- The development of learning through practical, problem-solving and work-related methods, in realistic contexts, and in close co-operation with local industry through a two way process of links between schools and business.
- The development of study skills including independent learning, investigation, creative design, and innovative resolution of problems and evaluation of outcomes.

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— The promotion of informed careers education and guidance in schools, with particular support for informing pupils about careers in science and engineering.

(b) *In Further Education and Training for 16- to 19-Year-Olds*

— High quality education or training to NVQ level 3 (or broadly 2 A or AS equivalent), as a norm for all 16- and 17-year-olds who can benefit from it.
— An increase in the all round levels of attainment by young people, and particularly an increase in the proportion of young people acquiring higher levels of skill and expertise.
— Maintenance of the standard of the academic route to higher education through A and AS levels and reform of existing vocational qualifications into a coherent national system of NVQs and General National Vocational Qualifications (GNVQs) to help raise the esteem in which vocational qualifications for young people to progress to higher levels, whether through higher education or further training.
— The development of self-reliance, flexibility and broad competence as well as specific skills, knowledge and understanding.
— The development of careers education and guidance to enable young people to make informed choices between those options on the basis of personal abilities, aptitudes and aspirations, and in the light of signals from the employment market.

II. Programmes and practice 5-16

(i) *The National Curriculum*

6. All pupils are required to study from 5 to 14 the National Curriculum consisting of ten subjects: the core of mathematics, English and science, together with technology, history, geography, music, art and physical education, and in secondary schools only, a modern language. Religious education must also be studied while pupils are at school.

7. For each National Curriculum subject, a statutory framework has been devised which sets out the learning attainments expected of pupils, in terms of the knowledge, skills and understanding they should acquire, normally on a 10 level scale, the highest point of which is above the top current GCSE grade. The framework also sets out the programmes of study through which pupils should address these attainments. Pupils are regularly assessed on their progress at 7, 11, 14 and 16. At 16, most pupils will be assessed on their achievements in National Curriculum subjects by means of the GCSE.

8. At 14, however, the Government has introduced some flexibility so that, when the National Curriculum is fully implemented (see Annex A) all pupils will continue to study as a minimum the core subjects, technology and modern foreign language, either history or geography, and a basic course in physical education. This leaves a maximum of 30 per cent of schools' timetable available for further study, whether academic (permitting for example pupils to study three separate sciences to GCSE) or more specifically vocational (leading to the achievement of credits towards a full GNVQ or NVQ post-16), as a basis for more specialised study or training post-16).

(ii) *Science in the National Curriculum*

9. The frameworks for science and mathematics were the first to be developed in the National Curriculum, and began to be implemented in schools in the autumn of 1989. The science framework is focused on four areas of attainment, one concerned with scientific investigations, and the other three corresponding broadly to the traditional categories of biology, chemistry and physics.

10. Initial reports from Her Majesty's Inspectorate on the implementation of the framework suggests that the range and standard of scientific work in schools have significantly improved, particularly in primary schools, and that the amount of time devoted to the study of the subject has increased. Pupils in the early stages of secondary schooling are acquiring a sound knowledge of a wide range of scientific ideas, and are beginning to plan investigations and interpret evidence.

11. For 14-year-olds, all schools are expected to offer a double science course leading to a double GCSE award, which is assumed to take about 20 per cent of school curriculum time, covering nearly 90 per cent of the concepts in the three previous GCSE separate science syllabuses. The Royal Society, the Fellowship of Engineering, and the Association for Science Education, and other distinguished bodies have all supported this integrated National Curriculum approach to science as an excellent preparation for more advanced study of science at 16-19 and beyond. The Royal Society announced in 1990 that this approach had its full approval for all pupils including those who would eventually become the nation's leading scientists.

12. A recent report by the Association for Science Education notes that the trend towards taking double science has coincided with an increase in the uptake of science A levels, and another report, commissioned

by the Royal Society and Department of Employment, concludes that students from a balanced science background of this kind obtained A levels results comparable to or better than, those gained by students from the more traditional single science background.

13. This evidence relates to double award science courses preceding the introduction of the National Curriculum which in science will not be assessed at 16 until the summer of 1994. The introduction of National Curriculum science for all should introduce still greater breadth and rigour to scientific learning in school; encourage and motivate more pupils to pursue further scientific learning and take up careers in science; and assist them in obtaining high standards of achievement at 16 as a sound basis for this.

(iii) *Technology in the National Curriculum*

14. The National Curriculum aims to ensure that all pupils develop a broad understanding of technology in a range of contexts both as a basis for more specialised courses or training after the age of 16, and as part of their preparation for adult life more generally. To this end, the statutory framework requires the application of scientific and mathematical concepts to practical problems, working not only with the construction materials traditionally associated with craft and design, but also food, textiles, graphic media and information technology, all in a business context.

15. While practical skills are recognised to be important, the framework does not take the narrow view of technology which the reports recently published by the NIESR appear to advocate. Rather, practical skills will be taught within a framework which encourages pupils to consider needs and opportunities, to resolve problems, to design and make products for a specific purpose, and to evaluate the extent to which they have met their objectives. In this way, the curriculum seeks to encourage pupils to be imaginative and innovative, with a view to preparing a flexible and adaptable workforce for the 21st century, capable of coping with the rapidly changing face of technology.

16. Statutory attainment targets and programmes of study for technology were introduced for pupils aged 5, 7 and 11 for the first time in Autumn 1990. Reports from HMI have shown that schools have made progress in implementing technology as an essentially new subject and that the broad, conceptual framework has been accepted. It had become clear, however, by June 1992 that some teachers, particularly non-specialists, had experienced practical difficulties in interpreting the requirements, so a decision was taken to review them.

17. The independent review group, headed by members of HMI, was asked specifically to clarify the links between technology and other subjects notably mathematics, science and art. The review has also addressed the question of flexibility to allow pupils the option to follow their particular interests and aspirations more closely at 14, while continuing to build upon the essential core of knowledge and skills. The proposals published for consultation in December envisage clearer links with vocational qualifications and more effective progression from compulsory education to more specialised courses after the age of 16, academic or vocational.

18. To assist with the implementation of National Curriculum Science and Technology, the Government has provided substantial additional resources by means of specific grants to local authorities. Between 1989 and 1992, the Grants for Education Support and Training (GEST) programme supported some £390 million of expenditure on activities related to the National Curriculum generally. This financial year, the programme will support a further £180 million of expenditure under this heading, of which £85 million will relate to the provision of books, equipment and in-service training. It is for each local education authority, and increasingly for schools themselves, to identify the specific needs of their staff and to decide how these needs may be addressed most effectively.

19. Apart from a distinct attainment target for IT in Technology, the frameworks for other subjects, including mathematics and science, also create obligations to use IT. Non-statutory guidance for IT capability identifies five strands: communicating information; handling information; modelling; measurement and control; and evaluating applications and effects.

20. There has been a central Government lead on the curriculum use of IT in schools since 1980-81. The Department has supported since 1988 expenditure of £135 million mainly on increasing computer provision in schools and training teachers in the effective use of IT. A further £30 million is being supported in 1993-94. The Department also supports through grant the work of the National Council for Educational Technology in providing support for schools, LEAs and teacher trainers; and also specific programmes to develop and apply newer technologies, for example CD-ROM and associated software, and more recently portable computers and interactive video technology.

21. The latest statistical survey undertaken by the Department in March 1992 indicates that schools' total expenditure on IT equipment in 1991-92 was £109 million; that the percentage of staff confident in the

use of IT is continuing to increase, particularly in primary schools where 72 per cent of staff are now confident in IT use; and that the number of computers in schools has more than doubled since 1988. There are now on average 25 pupils per micro in primary schools, and 13 per micro in secondary schools. Further evidence of the positive contribution of IT to children's learning is provided by HMI reports, which indicate progress towards the attainment targets of IT in the National Curriculum, and also by the report by King's College, London, on "The Impact of IT on Children's Achievements", which shows a significant impact in certain subjects and age groups.

(iv) *Specialisation and Diversity in Schools*

22. The Department has established 15 City Technology Colleges in urban areas, as a partnership between central government and business. CTCs are independent schools offering free education to children from a wide ability range, and giving special emphasis to technology, science and mathematics. The CTC Trust has established an affiliation scheme to enable maintained schools committed to a similar curricular emphasis to benefit from the experience of the CTCs; there are currently 30 schools thus affiliated.

23. Building on the success of the CTC programme, the Government has encouraged the development of specialisation in technology through the Technology Schools Initiative (TSI): a programme of capital investment to enhance technology teaching in over 220 maintained secondary schools. Each school has prepared a technology development plan which it is now implementing, with support from DFE and OFSTED. A network of TSI schools has been established, to enable new teaching materials to be tested and for the benefits to be fed back to technology teachers in other secondary schools.

24. Some TSI schools will want to go further, and to commit themselves to especially high standards of teaching in technology and related subjects. They may wish to do this in partnership with business sponsors. Under the legislation now before Parliament, grant-maintained and voluntary aided schools will be able to bring sponsors or their representative onto their governing body, thereby bringing in extra resources and managerial expertise. Schools which meet the relevant criteria will become technology colleges. The Government intends to announce details of the technology colleges programme later this year.

(v) *Teacher Supply and Training*

25. Teacher training and supply policies are designed to ensure an adequate supply of appropriately trained teachers of science and technology. Tax-free bursaries of £1,000 (in addition to any student grant/loan) are offered to encourage recruitment to post-graduate teacher training courses in these subjects, and recruitment is currently buoyant. The Government has recently launched an initiative designed to encourage schools to take a leading role in the design and delivery of initial teacher training and this includes a programme under the auspices of the CTC Trust for teachers of technology.

26. The late 1980s were characterised by a consistent failure to reach intake targets to initial teacher training (ITT) in science and technology, and significant teacher shortages in schools. By 1990 vacancy rates in secondary schools had risen to 1.5 per cent in science and 1.1 per cent in craft, design and technology (CDT). ITT intakes rose slighly in 1990, though were still below target. Significant rises in both science and technology were experienced in 1991, when target figures were exceeded by 12 per cent and 19 per cent respectively. Entry to science ITT courses in 1992 remained at the 1991 level, while technology recruitment continued to rise by a further 15 per cent. In schools, vacancy rates have now fallen to 0.2 per cent in both science and technology.

27. Vacancy rates however mask significant differences in the proportion of teaching delivered by appropriately qualified teachers. In the sciences, less than 10 per cent of tuition is by teachers without a higher education qualification in the subject taught or a closely related subject (about half the rate applicable across the whole curriculum). In technology/CDT, however, the figure is almost 40 per cent, reflecting the shift in the school curriculum from craft to technology and the fact that there is no history of "technology" qualifications as such.

28. Reports have consistently pointed to the need to improve the quality of science teaching in the primary school. The demands of the National Curriculum bring this into sharp focus. For 1993-94, of the GEST specific grant programme supporting LEA expenditure on the implementation of the basic curriculum and assessment, some £45 million is specifically for in-service training of teachers. Although some £8 million will go towards designated courses to enhance primary teachers' subject knowledge in science and technology, it is otherwise for schools to determine what proportion to spend on training for these subjects. They will take such decisions within the framework provided by staff appraisal, school development planning and school inspection.

29. As more pupils encounter science throughout their school careers, the problem should reduce. In the meantime, however, the A level backgrounds of primary teacher intakes are biassed towards the arts and

social science subjects. The Department has asked the HEFCE to consider how it might facilitate an increase in B.Ed and PGCE courses specialising in science and mathematics; and the Open University is seeking a significant bias towards the sciences in the primary intake to its new distance learning PGCE course. The Department is considering the case for an entry requirement of GCSE science or an equivalent as a condition of approval for primary initial teacher training (ITT) courses.

(vi) *Encouraging Innovation and Appreciation of Industry's Needs*

30. Encouraging innovation is not directly a matter for the content of the curriculum. It is rather a function of how that content is taught. Building on the Technical and Vocational Education Initiative (TVEI), funded by the Department of Employment since 1983, the National Curriculum envisages the development of work-related curriculum, and the promotion of active learning. This means that where possible the curriculum is taught using contexts drawn from the world of work; rather than learning in the abstract, and applying problem solving and investigative techniques to learning—and study skills—encouraging pupils to take responsibility for their own learning. These developments are intended to help with developing in children the skills of innovation required by industry in the future.

31. Activities such as work experience and visits to businesses offer many opportunities for project and assignment work. Such joint activities between education and industry can contribute directly to the delivery of the curriculum and many projects are specifically intended to help promote the development of science and technology in schools. They also help to prepare young people for the responsibilities of adult and working life and provide employers with a workforce which has the required understanding, skills and aptitudes.

32. For instance, links with business are reinforced by programmes such as Neighbourhood Engineers, run by the Engineering Council and part funded by DTI, which provides for professional engineers to assist secondary schools with technology projects. The Science and Technology Regional Organisation (SATRO) also brings industry and education together to enhance the curriculum. DTI's work related curriculum programme has co-sponsored with business the preparation of curriculum materials which provide real life examples based on the world of work. There are also a number of effective business link schemes which bring schools and industry together. These are co-ordinated under the umbrella of the local Education and Business Partnerships.

33. The latest data available indicate that school-business links continue to flourish. In 1992:

- Ninety-two per cent of secondary schools and 56 per cent of primary schools had links or contacts with local business.
- Ninety-one per cent of pupils in their last year of compulsory schooling were involved in work experience placements compared with only 15 per cent in the mid 1970s.
- Fifty-one per cent of secondary schools said that work experience had contributed to assessed GCSE course work (specifically to science and technology in the case of 16 per cent of these schools).

34. Pupils are also expected, throughout the National Curriculum to develop economic and industrial understanding, including a grasp of basis economic concepts; skills to investigate and analyse economic issues; the attitudes needed to participate responsibly in economic life; and direct experience of industry and the world of work.

35. Careers education and guidance has close links with education for economic and industrial understanding. It is for schools to decide how to approach the topic, but the Department for Education has collaborated closely with the Department of Employment, which has responsibility for the oversight of the Careers Service, to promote informed and impartial careers guidance in schools. Over recent years there have been increasingly close links between careers staff in schools, Careers Officers and other directly interested parties, including employers. The spread of voluntary partnerships between local education authorities and Training and Enterprise Councils (TECs) for the management of local careers services has taken these collaborative links further.

36. The Department for Education, the Department of Employment and the Department of Trade and Industry are jointly sponsoring the production—under the auspices of the National Council for Educational Technology—of an interactive video and materials to help a range of teachers of 14 to 18-year-olds to bring a greater careers focus to their work. DTI, jointly with industry, is also sponsoring a major video "Innovation" Wealth from Science and Engineering which is aligned with the National Curriculum. Its dissemination to over 3,000 schools will be accompanied by a number of local business school events.

(vii) *Examples*

37. Some brief examples from OFSTED inspections may assist in appreciating the degree of progress being made already in the nature of the scientific and technological experience at school over the last few years with the gradual introduction of the National Curriculum and the impact of the developments outlined above.

(a) In a Year 1 Science lesson (for five year olds), investigations were arranged to test the waterproof properties and elasticity of various materials. These enabled the pupils to develop the idea of fair testing. The teaching objectives were clear, and good quality learning occurred as pupils listened, observed, predicted, experimented and recorded. In addition conclusions were drawn about the relative merits of the materials in the production of garments.

(b) In a Year 9 class (for 14-year-olds) the teacher introduced the task of investigating the effect of passing an electric current through a solution of sodium chloride. Pupils were encouraged to make predictions; they recalled earlier work with copper sulphate. They planned and carried out investigations relating current and time to any changes in the electrode weight and the gas evolved. They were able to draw upon and use, existing knowledge and further their understanding of the complex process of electrolysis.

(c) In one primary school a class of Year 1 and Year 2 pupils (five- and six-year-olds) made and tested simple kites while a class of Year 3 and Year 4 (seven- and eight-year-olds) pupils designed and made anemometers to test wind speed.

(d) In many of the best primary lessons the pupils understood the properties of materials, were able to give reasons for selecting chosen construction techniques and developed good manipulative skills when cutting and shaping fabrics, timber, card, metal, and plastics, and when preparing food. One year 3 class visited a local fire station and subsequently designed fire fighting equipment.

(e) One 11-18 TSI school has a number of strong links with industry and pupils projects at KS4 and 'A' level are regularly linked to industrial product development. This school's Design Centre is supported by local companies and features displays and examples of pupils work and products produced by local industry. Developments build on the existing strong curriculum links between art and design and technology at KS3 and KS4 and enhance the existing provision in areas of "applied technology, i.e., control technology, electronics and robotics.

(f) A rural 11-16 school had good links with the local community and the village signs, commissioned by the local council, have been designed and made in the technology department. In their designing and making pupils took account of wind forces, materials technology and social factors such as the need to ensure the signs would resist vandalism. There were good links with local industry, with regular contributions to lessons by engineers and financial advisers.

III. Programmes and practice 16-19

38. The Government's policies for post-16 education and training depend upon promoting an informed and rational choice from a range of options, in schools and further education, leading to high quality qualifications. The key qualifications for those in full-time education will be A Levels, AS and GNVQs.[3]

39. The Government is committed to retaining all that is good in A levels. They are a well-established and well-regarded qualification which serves effectively those for whom it was designed. The Schools Examination and Assessment Council is currently collaborating with the GCE Boards to implement detailed criteria to underpin the A Level Principles, agreed with the Secretary of State in 1991.

40. There has been a steady rise in the proportion of young people taking A Levels, passing them, and passing them well, since aggregate figures were first available in 1989. The proportions of candidates passing and getting good grades in science and technology subjects at A level have also risen since 1989.

41. Advanced Supplementary (AS) examinations, which are pitched at the same standard as A level but cover approximately half the content, provide significant additional flexibility in the A Level system, and are a useful instrument in designing broader A Level programmes. They permit students to add contrasting subjects to their main courses of study post-16, which can lead to new perspectives in traditional studies and more flexible and innovative problem solving.

42. Vocational qualifications are playing an increasingly important part in raising overall levels of achievement, particularly in the science and technology areas. At present, about one in ten entrants to degree level study have followed the vocational route. In engineering this figure increases to one in five.

43. The Government is reforming vocational qualifications into a new national system that is easier to understand. Older style vocational qualifications will be accredited as either National Vocational Qualifications (NVQs) or General NVQs (GNVQs).

44. Each NVQ and GNVQ will be at one of five levels. The table sets out these levels and shows very broad equivalences, illustrating how qualifications at each level might lead to further study or employment.

NVQ Level	Description	Broadly equivalent to:
5	Profession, Middle management.	Higher Education
4	Higher technician, Junior management.	
3	Technician, Advance craft, Supervisor	2+ A Levels (or equivalent in AS)
2	Basic craft.	4+ GCSEs A to C
1	Foundation.	Other GCSEs

45. NVQs are based on national standards, which define the skills, knowledge and understanding that employers need. The performance of students is assessed in workplace conditions and the NVQ is a guarantee of competence to do the job. NVQs are likely to be best suited to those already in employment.

46. GNVQs, by contrast, are designed primarily for young people in full-time education who want to keep their options open. They will prepare young people for a range of related occupations, as well as for higher edcucation. All GNVQs will develop skills in communication, numeracy and the use of information technology. Like NVQs, GNVQs will be made up of units to facilitate credit accumulation. The Secretary of State asked the National Council for Vocational Qualifications (NCVQ) and the awarding bodies to aim towards catering for half the age-groups by:

— Making GNVQs in at least two subjects available in at least 1,500 schools and colleges by 1996.
— Enabling one in four 16-year-olds to start GNVQ courses in 1996.

47. The first GNVQs are currently available in about 100 schools and colleges in five occupational areas: manufacturing; art and design; business; health and social care; and leisure and tourism. More are being developed including in science and engineering.

SECTION B: SPECIFIC QUESTIONS

Question 1: To what extent does the Department see the education system as responsible for providing the skilled work force that industry needs? What is industry's role in this?

The aims of *compulsory education from 5-16* must be to prepare all pupils for adult life, and to provide a flexible basis for whatever career option a pupil may subsequently choose. A sound grounding in the basic skills of literacy and numeracy, and other skills such as basic modern language competence and the application of information technology, and the provision of a broad grasp of knowledge, skills and understanding which promote the spiritual, moral, cultural, mental and physical development of pupils are valuable elements in this, but are also relevant to developing in pupils those skills and aptitudes which are needed by industry.

As pupils become clearer about their career aspirations, they need opportunities to pursue studies with more specific vocational relevance. At the 14-16 stage of compulsory education, there is sufficient flexibility for them to focus their studies in areas relevant to those aspirations, whether by increasing emphasis in a particular area such as science; by adding to the range of their skills by studying new areas such as economics; or by developing more specific industrially related skills, knowledge and understanding, through units of vocational qualifications designed to meet the needs of particular industries or sections of business.

The further education (FE) sector has a key contribution to make to meeting the needs of employers for high quality, highly skilled recruits and to improving the skills of the work force—the skills needed to achieve the National Targets for Education and Training. The expenditure plans announced by Government give high priority to the funding of further education in support of this. The planned increase in funding for the new sector will allow for a 25 per cent increase in student numbers in England between 1992-93 and 1995-96. Total recurrent spending is planned at £2,549 million, £2,734 million and £2,943 million in 1993-94, 1994-95 and 1995-96 respectively.

1 April saw the launch of a dynamic new FE sector. The reforms are intended to give colleges the freedom to respond quickly and flexibly to their customers—students, employers and the local community. The new funding mechanism will ensure that those colleges that gauge their market best and are most successful in attracting students will be the most successful financially, since part of their funding will be directly related to student numbers and will be non cash limited. Increased freedom will also allow colleges to meet the increased demand from industry for more flexible, part-time methods of delivery, including distance learning as more companies seek to improve employees' skills.

Colleges will be encouraged to develop partnerships with TECs in the delivery of high quality education and training for local business. TECs have a great deal of expertise to offer to colleges on local business needs. They have been given responsibility for developing local strategies to achieve the Targets, and will need to work closely with colleges in order to do this. In recognition of the growing importance of this relationship, TECs now have a representative on each college corporation, and there will be two TEC representatives on each of the nine regional committees in England which advise the Further Education Funding Council.

More generally, industry has a vital contribution to make to education at all levels. Experience has shown that close working relationships between employers and schools and colleges can lead to mutual benefits. Employers can provide experience of the world of work for both students and teachers. They can also ensure that the Education Secretary is aware of their needs in terms of skills and standards achieved. They can share their expertise on the provision of vocational education and training.

Question 2: What arrangements exist to ensure liaison between the DFE, the Department of Employment and the Department of Trade and Industry?

There is close day-to-day collaboration between the three Departments on a wide range of issues and initiatives. This is formalised through the Education Business Interdepartmental Group, which comprises members from DTI, ED and DFE, together with representatives of the Scottish and Welsh Offices, which meets regularly. Its remit is to ensure coherence and co-ordination of work in the education-training-business area; and to advise Ministers on future Government strategy and proposals for new programmes.

DFE collaborates closely with the other Departments in specific links programmes, including the TVEI, Compacts and the Education Business Partnership initiatives, which are funded by ED. In addition to their work with TECs and on the National Targets, the Departments of Employment and Education work closely on policies related to Youth Credits, work related further education funding, careers guidance, and the recently announced Learning for Work initiative.

Question 3: What arrangements exist for liaison between the Department and the National Council for Vocational Qualifications? Does the DFE have any responsibility for ensuring the National Council for Vocational Qualifications takes industry's needs adequately into account?

The Department Education is one of the sponsoring Departments for the National Council for Vocational Qualifications, and contributes substantially to funding the Council. DFE and DE Ministers and officials liaise very closely on NCVQ business, and regularly meet the NCVQ Chairman and senior officers. DFE assessors sit on the National Council and the main policy committees of the NCVQ.

Like the Department of Employment the DFE is concerned to ensure that the NCVQ take full account of the needs and views of industry in their work, as well as those of the education system and the public more generally.

Question 4: Were other Departments of State consulted as part of the process of determining the National Curriculum, if so, which were these? Was industry also consulted? Were any consultations specifically made over the science and technology curricula?

Each National Curriculum subject was developed in the first place by a working group appointed by the Secretary of State, comprising teachers, academics, representatives of business and industry and others. These groups consulted widely on an informal basis, and produced reports which were published by Government, usually as a basis for formal proposals which were then subject to two rounds of statutory consultation. Those consulted in every case included representatives of business. In the case of technology, a particularly wide range of industrial interests was included. In addition, one of the rounds of statutory consultation was always undertaken by the National Curriculum Council, which itself includes people drawn from industry and business, as well as from education, and which brought its experience to bear in recommending to Ministers any changes needed to the initial proposals. The Schools Examination and Assessment Council, which advised on the assessability of the proposals, is similarly constituted.

The proposals were widely published, so Departments of State were able to comment if they wished, but in all cases copies were sent to the Welsh Office Education Department (where the proposals were not joint for England and Wales); to the Scottish and Northern Irish Education Departments; and to the Departments of Employment and Trade and Industry. Other Government Departments were consulted formally where relevant to the subject. The revised technology proposals were, for instance, discussed also with the Department of Health, the Ministry of Agriculture, Food and Fisheries, and the Health and Safety Executive.

Questions 5: What assessment has been made of the effectiveness of schemes intended to link schools and business?

A recent OECD report commended the UK as having developed a "sophisticated model" for partnerships between schools and businesses in the shape of a broad and flexible national policy framework which encourages and supports local initiative, suggesting that this has placed the UK in a "favourable position" among OECD Member States.

Several reports, from Her Majesty's Inspectorate and others, have found that working with business can be a powerful stimulus to learning, but that many schools are not extracting the maximum benefit from their links with business. In 1992 DFE therefore commissioned (with support from ED and Esso) a study of the effectiveness of link activities which resulted in a recent publication entitled "Building Effective School-Business Links". This offers schools advice on getting the best value from link activites, encouraging them to ensure that such activities are well-planned, integrated into the curriculum and properly evaluated, identifying other factors leading to effective links work and giving examples of good practice.

Question 6: Does the DFE (as opposed to the DE, which is responsible for the Careers Service) have any programmes to encourage contact between schools and further or higher education institutions?

There are no specific programmes solely concerned with encouraging such contact. Many of the links schemes between education and business cover the education system at all levels and therefore encourage links between those levels at the same time as those between education and business.

There is extensive contact between schools and higher education institutions through local initiatives, which provide information for pupils about the opportunities available, and increasingly encourage the sharing of expertise, equipment, resources, and even staff between schools and further education institutions.

Question 7: What links does the Department have with the education departments of other countries? What efforts are made to learn from other systems?

The Department has a wide range of links with Education Ministries in other countries. Activities range from informal exchanges of ideas and experience on policy developments within the education field to large-scale bilateral Colloquia to promote educational exchanges and support the teaching of each other's language in the partner country. Formal programmes have been agreed with several European partners to further develop and extend bilateral co-operation in education.

There is also contact with Education Ministry officials at monthly meetings of the EC Education Committee. These meetings are primarily for discussing the initiatives on the agenda for the six monthly EC Presidency. They also offer officials the possibility of discussing developments in their own education systems. In addition, officials from policy branches attend meetings of some 13 EC working groups concerned with co-operation in specific areas.

The Department both supports and consults the EC Eurydice network which provides comparative information on the education systems of all EC Member States. Members of the Department and OFSTED participate in the EC's ARION study visit programme which aims to provide opportunities for senior education officials to investigate a given theme of common concern to Member States. During the visit participants have the opportunity to observe general education provision in another EC country and to investigate in more depth one or more aspects of the provision.

The Department also participates in the educational activities of the OECD and the Council of Europe. Senior staff attend key policy committee meetings. As with the EC, the Department arranges for representation at other meetings relevant to its policy objectives.

Both OECD and Council of Europe provide a forum for facilitating international co-operation in the field of education and training. The OECD focuses on the contribution of education to social and economic competence, skill formation and the application of knowledge and skill in social and economic life.

Work is undertaken through projects and meetings of OECD's Education Committee and its Centre for Educational Research and Innovation (CERI). The latter promotes the development of research activities designed to test educational innovation and stimulate research and development. A key education objective of the Council of Europe is to help education systems anticipate and adapt to the changing needs of society, particularly in respect of the need for a well trained and adaptable workforce.

In addition, members of OFSTED visit other countries and publish inspection reports on particular aspects of their education systems. Recent publications have included Teaching and Learning in Japanese Elementary Schools; Aspects of Primary Education in the Netherlands; and Aspects of Higher Education in Germany: Design, Technology and Engineering 14-19.

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Examination of Witnesses

MR ROGER DAWE, Grade 2, Further and Higher Education, MR CLIVE SAVILLE, Grade 3, Schools 3 Branch, MR STEPHEN CROWNE, Grade 5, Further and Higher Education Branch 2, and MR ROB HULL, Grade 5, Further and Higher Education, Branch 1, of the Department for Education, were examined.

Chairman

208. I must apologise to you that although we are quorate, and that is the first thing anxiously in your mind, we are somewhat bereft of members because of events going on downstairs. I know you will understand why we are a bit thinner on the ground than we would wish to be. That does not mean however that we have not got some good questions to ask you about the Education Department and its role in the inquiry we are conducting. Just to remind you, in case you have forgotten, we are trying to evaluate the routes by which successful, competitive innovative technology is derived from the UK Science Base, and we are comparing it with the patterns and progress of other comparable industrial countries. Further education plays a substantial role in this, and indeed in the visit we made to Germany not long ago there was emphasis on the amount of educational effort put into the development of technology and so on. May I start off by saying that your Department and your Secretary of State is responsible, and I quote, "for helping to secure an adequate supply of people qualified in science, mathematics, engineering and technology subjects". Surely you must have found a number of areas where the supply has clearly been inadequate, and what are you doing about it?

(Mr Dawe) Would it be helpful if I introduced my team first, Chairman?

209. I am sorry, I should have asked you to do that.

(Mr Dawe) I am Roger Dawe and I head the Further and Higher Education half of the Department. I have with me Clive Saville, on my left, who is head of one of the schools branches and can deal with questions relating to schools. On my right is Rob Hull, who is in the higher education branch, universities and so on, and on the far left is Stephen Crowne, who is in the further education branch.

210. So we are covering higher education plus schools?

(Mr Dawe) I hope we have a team capable of answering all your questions. We shall see as we go along.

211. The first question is, with your responsibilities for the provision of those adequately skilled in teaching technology subjects, there is clearly a problem of adequacy of supply. Would you tell us (a) is that a fact and (b) if it is, in what ways is the supply being encouraged or restored?

(Mr Dawe) Thank you, Chairman. First of all we accept there is an increasing demand for higher level skills, especially involving science and technology. In the broadest of terms I think our Department has a very important role at every level. At the schools level it essentially means lifting standards and quality in schools, getting more young people up to the age of 16 well qualified in the widest possible range of subjects, which is the purpose of the National Curriculum. Secondly at further education level, primarily covering 16 to 18 year olds, we accept there is a need to expand that sector and provision is being made for that, and to promote particularly vocational qualifications within further education so more young people have the opportunity to get vocational qualifications at a higher level. Then, to complete the system, at higher education there is a particular need for skills at levels 4 and 5 in terms of vocational qualifications, and there again there has been a very large expansion in higher education, and science and technology have played a full part in that expansion. So we would accept that this is a very important area and we would accept education has a very important job to do at every level—schools, further and higher education. Finally, I might say, not just for young people but for adults who are already in the labour force.

212. Would you agree with Robin Nicholson of ACOST that there is a gap, a vacuum, from people with honours degrees to people with nothing, and it is in this central region of technicians where the UK misses out?

(Mr Dawe) Yes, I would go a long way in agreeing with that. I think a number of studies have shown, including the National Institute of Economic and Social Research, that there is a particular problem at technician level. I think we have a very effective higher education sector now and a much expanded one, but we certainly fall behind some of our competitors at technician level. That is one of the main reasons for the attempt to promote further education and particularly to promote vocational qualifications within the further education sector. I think that is an important area to be addressed.

Lynne Jones

213. We now have the National Curriculum and obviously all school students are encouraged to get a basic groundwork in a wide range of areas. Beyond that, there seems to be an encouragement for schools to specialise in particular areas, and we have of course the city technology colleges and other initiatives along those lines. Yet when 11 year olds

[**Lynne Jones** *Contd*]

start their secondary education they probably have not yet decided what course they wish their career to follow, so why should not all schools have access to the same kind of facilities in science and technology which are available in for instance the city technology colleges?

(Mr Saville) City technology colleges are the flag ship of the Government's concern to promote technology and aspects of specialisation in secondary schools. There are a significant range of other initiatives of that kind, starting perhaps with the technical and vocational education initiative, TVEI, back in 1987, which is now a little more than half way through its decade. There has been the technology schools initiative more recently, which has given significant extra resources to about 5 per cent of secondary schools to enable them to develop their technology provision. I have visited a couple of schools recently which have been spending their extra grants to very good effect. Of course there is the Government's new policy also for the development of technology colleges which was set out in the White Paper last autumn.

214. But this will only reach a proportion of schools. Obviously lessons have been learned from these initiatives, are there any plans to extend them more widely and make them more widely available to the majority of schools?

(Mr Saville) Ministers are considering whether there should be another round of the technology schools initiative, but as I say these are, if you like, the flag ship activities which are designed to encourage everyone. All schools have budgets and all schools are free to take decisions about how they use those budgets in support of particular specialisms, whether technology, languages, music or other things on which they want to concentrate.

Mr Miller

215. Moving on to the teaching of technology in the secondary curriculum, we have heard some views from experts in evidence so far about the standard to which this is being taught. In my own mind I try to compare this with things which happened to me when I was at school, and I discuss this matter quite frequently with teachers in my own constituency who are expressing some very serious concerns. Could you give me an idea of the level of skill and to what standard technology is taught in the curriculum today? What, say, should a pupil who gained an average grade, a C grade, at GCSE be able to do? And could you do it?

(Mr Saville) I think in a sense, Chairman, that is very much the right way of phrasing the question because the National Curriculum has been designed to try and identify what pupils should be able to know and understand and do, and a lot of the emphasis in developing National Curriculum technology has been on "doing". It has been one of the most difficult subjects to get launched in schools because it is a subject in which most schools have least experience, and it is not a subject which is easily defined. But we are particularly concerned that pupils should receive an introduction to the broad concept of technology, to the idea of designing a product to meet a particular need, evaluating the plans for that product, actually making it and looking at it to see whether it meets the need. But within that broad technological context, we are concerned that pupils should spend a large proportion of the time they devote to technology on the hard realities of actually making good quality products, and that would take up most of their time. If, for example, you look at the proposals for technology which the Secretaries of State published earlier this year, which are currently the subject of consultation, to try to give you some examples of the sorts of things which would be taught to pupils between 14 and 16, one is talking not only about basic skills like using drilling machines to make holes at proper angles, but about selecting and using appropriate methods of shaping and forming materials in a variety of different ways, using computer-aided design techniques very often, so they are doing things like injection moulding wheels, casting aluminium alloy to make a bearing, vacuum-forming plastic sheet to make part of a construction, as well as the craft skills of actually being able to get a proper right angle, being able to saw accurately, cut and measure and fit and make things stick together. And as you progress through the National Curriculum levels, things like using tools and equipment to ensure for example that the speed at which a cutter is operating and the rate of feed will give you the quality of finish you want. So at its best it is really quite a sophisticated approach to using technology in support of making things.

Dr Bray

216. In your memorandum you say in paragraph 15, "While practical skills are recognised to be important, the framework does not take the narrow view of technology which the reports recently published by the National Institute of Economic and Social Research appear to advocate." I am sure you have seen the revised version of Bierhoff and Prais's paper published in the National Institute Economic Review in May. There they do address themselves to the changes in the technology curriculum which are being proposed and point out they do not really change very much. On page 67 of the May Review a distinction is made between continental educationalists and employers and they lay emphasis not only on the particular value of educational skills applied by pupils but perhaps even more on the lesson of good working habits in terms of clean working, precision, perseverance and responsibilities. They go on: "British schools have progressively moved this part of the curriculum towards a more intellectualised approach, emphasising problem-solving, design and evaluation in complex or highly generalised contexts (eg designing an airport). Unless practical subjects are intellectualised and linked to academic subjects and bulky paper-work

[**Dr Bray** *Contd*]

activities, they continue to be regarded as not having a wholly legitimate place in the school curriculum in Britain." Do you recognise the criticism?

(Mr Saville) I recognise it as a criticism of something we are trying to get away from. I certainly do not think that technology ought to be about purely hypothetical design exercises of the kind you have described. The new technology proposals are very much concerned throughout with developing severely practical skills and throughout you will find that there is emphasis on things like developing good working habits, planning a piece of work in practical terms to make sure you can carry it through, and concerns with safety considerations, all the sorts of severely practical things you talk about. But I think it is important also to remember that National Curriculum technology is being developed as a subject to cover and be attractive to the whole range of intellectual ability, and that means that as well as teaching simple handicraft skills if you like at one end of the spectrum you do also want to interest the brightest pupils——

217. But is the bright pupil merely interested in writing up the experiment at the end? Is he not interested in getting the experiment to work, to ensure the device he is making is a high quality device? Sometimes this is excused in terms of the cost of the equipment and materials, hence the emphasis on yoghurt pot technology in the class room, but in my own constituency recently I have found an admirably equipped technical room with the Fisher Technique, incorporating hydraulics, electronics and mechanics, and there I was told that the most important part of the exercise was writing it up afterwards.

(Mr Saville) I am sorry, Chairman, but I would disagree entirely with what Dr Bray was told. What I had been going on to say was that the intellectual excitement, if you like, comes from showing people what the latest technological techniques allow them to do. I was in a school recently where they had just acquired a computer-aided manufacturing machine which allowed pupils to programme the machine to cut precisely the shapes they wanted, and they could then actually try out the design, come back, try it again, see if it worked. That was tremendously intellectually exciting, and that was not about writing up, that was about doing and making and that is what we do want the curriculum to be about.

218. That opens up another criticism Bierhoff and Prais make, namely the attempt is made to go into fancy CAD and NC systems without pupils having the basic three dimensional geometry capacity to do the engineering drawing. Unless you have that basic command of shape and material, how can you sensibly use CAM-CAD equipment?

(Mr Saville) I sometimes think that Professor Prais has not read the new proposals for National Curriculum technology, because they have a clear foundation in the mathematics and science parts of the National Curriculum. You do not expect to have to teach them the maths of the National Curriculum over again in technology.

219. But science does not teach engineering drawing and the practical steps necessary to represent a three dimensional shape on a two dimensional screen?

(Mr Saville) No, but it does provide in the design arm of the curriculum for a proper development of drawing, both engineering type drawing and free hand drawing, to illustrate a design.

Mr Miller

220. Let me preface this by saying that I suspect I am the only person in the room who can still cut a dove tail having been taught in school, and you do not get taught those basic skills these days, despite the fact the design element and the use of hand tools does come into the curriculum. The criticism coming from the teaching profession and the people I have met in my own area is that the curriculum is expected to express so much and concentrate so much on the evaluation element that not enough time is being spent on the teaching of the basic skills, the ones which would enable the pupil to leave school today knowing how to cut a dove tail. If I can just take an example out of the information technology package, the version of that document you are referring to there which covered the key stage 3 information technology course, the block that was designed for IT teaching this year I thought was very good, except it was destroyed by one sentence—and this is the sentence if you look at the comparisons which makes the NIESR's report fall right into place—and it was the single sentence which said, "At the end of 1993 this block will be tested by a one hour written test." It took children away from the hands-on practical IT teaching. It may have given some benefits to the most literate children but not necessarily examine them in the subject which the course was supposed to be all about. That to my mind is the major criticism I have of the system as it stands.

(Mr Saville) Two points, Chairman. First, I very much agree that the National Curriculum in technology as it stands at the moment is very heavily over-loaded and is trying to do too much, and I fully understand the criticisms teachers have made of it, which is why we are trying to revise it. Revised proposals are currently the subject of consultation, and they have generally been welcomed as being clearer and more helpful even if they are still over-loaded. I agree also with your concern that as far as possible tests should be practical. In the design and technology part of technology, testing this year has been based on a practical test. That has not been possible in information technology.

221. You talk about the design of a bracket, I think?

(Mr Saville) Yes, that is right, the clamp.

222. You think that is adequate?

(Mr Saville) It is a start. It is the first time we have had to do something like that. It certainly has helped some people. It has helped people to focus on what it is they are trying to achieve, and it has ensured

[**Mr Miller** *Contd*]

people have actually made something as opposed simply to writing it up and evaluating it. It is logistically difficult to organise practical tests, so at the end of the information technology course pupils have to take a paper which does not test literacy significantly, and is not empty intellectualising, but asks people for practical answers which will be answers like, "You do this by moving the cursor from A to B", which are the things which should not cause people any difficulty. But I accept that there is a tension in trying to have written tests of practical subjects.

223. The difficulty there, just coming back to that specific example, is that test is not in front of the computer, it is only a pen and paper test.

(Mr Saville) Yes.

224. Just coming back to your previous answer in relation to the design and technology, do you really think for example that exercise on the design of the clamp has given pupils adequate training and education in the use of hand tools?

(Mr Saville) The clamp, which is perhaps the exercise I have seen most of in schools, has certainly given people a range of opportunities for different responses to the task.

225. Has it taught them to use the tools?

(Mr Saville) To some extent, yes, obviously, or they would not have been able to make the objects. But it is the first time there has been testing of that kind. The effects of the test will be evaluated and we want to move on from there to improve the testing.

226. I do not understand this concept that this is the first time. I was tested in the use of hand tools in O-level woodwork, a good numbers of years ago I have to say. This is not the first time, is it? It is the first time it has been done on the National Curriculum.

(Mr Saville) It is the first time it has been done in the National Curriculum context, yes.

Dr Bray

227. In trying to get the bottom of why you have this difference of emphasis with the National Institute, it seems that there is an unfortunate distinction which seems to have grown up in this country between education and training, and the war between the Department for Education and the Department of Employment on this matter. How many of you have worked as engineers or technicians in industry?

(Mr Dawe) None, I suspect. Although referring to your war, I have worked both in the Department of Employment until last August and now in the Department for Education.

Chairman: Good answer!

Dr Bray

228. But is there not a difference between that shaping—I do not know what your backgrounds are but not practical, industrial backgrounds—and shaping policy for practical industrial people? It is no good having advisers galore outside if it is then filtered through advice to ministers and departments which does not directly deal with the future?

(Mr Dawe) Mr Saville can elaborate on this. The National Curriculum has been very carefully prepared with experts as a result of a major consultation exercise in every case.

229. Yes, but in the nature of consultation exercises as carried out in the tradition of British Government they do not always reproduce the views of those consulted, do they?

(Mr Dawe) Mr Saville may be able to speak on this.

230. Can you compare the view you have put forward here with the traditions there were, of well-established craft training, of training of tradesmen in the Services where there were generations of experience in how to equip people with the skills necessary to do practical things?

(Mr Dawe) Those skills were often fairly narrowly based, and one has to review the requirements in relation to what is happening in industry. We want to go a good deal wider these days than the kind of metalworking and woodworking that I for example did at school.

231. But it is the underlying work habits—reliability, care, fulfilment of duty, diligence, patience, perseverance, accuracy.

(Mr Dawe) I would hope that those ingredients would emerge as a result of young people in schools working through the National Curriculum.

232. Take, for example, the skills needed in getting a software package to work, the necessity to check and check and check again, the absolute ruthless pursuit of accuracy there. Where is that reflected in this kind of approach to technology?

(Mr Saville) I thought, Chairman, that the information technology part of the National Curriculum and technology had been one of its most successful elements. We certainly have a very strong international lead in the use of information technology in schools, and I think this is beginning to pay off. There has been recent evidence that an awful lot of young school leavers are far happier using information technology than a lot of the people they are going to work for. So I certainly think the disciplines of information technology are starting to have the kind of effect you are talking about.

Dr Bray: That is not a relevant comparison. A relevant comparison would be those kids with their opposite numbers who have been through a more structured system as is Germany, Switzerland, Japan and France.

Lynne Jones

233. What comparisons have you done? You say in your paper you have lots of contacts with other education departments.

[**Lynne Jones** *Contd*]

(Mr Dawe) Certainly on the further education side, we for example have been in close touch with what is happening in Germany, in devising our own vocational qualifications at that level, and we make the kind of comparisons the National Institute make, and in many cases we would agree with the National Institute but not always.

Chairman: Can we turn to the teaching of mathematics, which is another fiercely vexed issue.

Mr Williams

234. Could I ask, and I think again this will be Mr Saville, on the teaching of maths in schools, as I understand it, the National Institute of Economic and Social Research in their reports find that when you compare Britain internationally the quality of our teaching for bright pupils compares very well, the high achievers do well, but at the bottom end, average or below average people, our results are way behind those of competitive countries. Why is it that for the below average child the teaching of mathematics particularly, but probably of science too, compares so badly?

(Mr Saville) It is something which has bedeviled our education system for a very long time, Chairman. We have had far too low expectations of what average and below average pupils are able to achieve. I think that the criticisms you quote are almost certainly justified. That is one of the reasons why the Government decided to introduce the National Curriculum, to try and ensure that standards were raised, that there were clear targets and higher expectations for what pupils would be able to achieve, and we are beginning to see the signs that that policy is beginning to bear fruit.

235. We have very much a kind of elitist educational system which gives a very good education to perhaps 10 or 20 per cent who can go on to higher education, and perhaps increasingly FE and higher education, but it is very much a one-third/two-thirds kind of society where the other two-thirds historically just have not had good quality education. When you compare us with Germany, Japan and the United States, good education does need to reach much more into the deeper echelons, we need a workforce which is skilled right the way through, 60, 70, 80 per cent of the people, rather than just the top 20 per cent.

(Mr Dawe) I think that is a perfectly fair criticism of our past performance, which is reflected in one of the National Institute's recent reports. What we would say to that now is that we are seeking to remedy that at every level through the National Curriculum. For all the problems it has had in its early days, it is designed so that all young people continue to do mathematics and technology and languages to the age of 16, everyone. There is no elitist approach there. Secondly, a major attempt is being made to increase the number of 16 and 17 year olds staying on in education or training, which again has been a very weak area of our performance in the past. Over 75 per cent of 16 year olds now are in full-time education or training, and about 50 per cent of 17 year olds. It is still not good enough but it is moving in the right direction.

Lynne Jones

236. What are the outcomes of this extra educational time? The cynical amongst us will say they have not got any choice. What are the signs that this approach is bearing fruit?

(Mr Dawe) I think that would be too cynical a view. My own view would be that as we emerge from the recession I think it would be very surprising if we see this participation rate dropping. What we are trying to do is to devise more courses for 16 and 17 year olds which will be attractive to them and which will lead to qualifications which will help them to get work. That is particularly true in the area of vocational qualifications. I agree, in the past the focus on A-levels alone, as it were, might well have turned off young people who were more inclined to go up a vocational route. We want to boost the status of vocational qualifications, and that is the thinking behind the general national vocational qualifications. Going on to higher education, we have now reached the position where no fewer than 28 per cent of 18 to 21 year olds are going into higher education, which is about double the rate only five years ago. While I think it is a perfectly fair criticism which the National Institute and others make, that in the past we have had this elitist approach—very good for the top 20 per cent, not so good for the other 80 per cent—I think at school level, at further education level and at higher education level we can now see trends developing which we want to encourage, which will mean there will be a good education for all, so that, for example, we hit the national educational and training targets which run across academic and vocational qualifications.

Mr Williams

237. I hope what you are saying is true and will happen, but historically if you look at the last ten to fifteen years, even longer than that, there has been a drift away from science, physics, chemistry and maths at A-level, and the expansion which has taken place in higher education has not been in these key areas, it has been in much softer options, I might say. There is a problem in that maths, physics and chemistry are immensely difficult A-levels, and that from year to year and from decade to decade they are becoming increasingly difficult as academic subjects.

(Mr Dawe) We can give some figures on this point which actually do show that the percentage of people leaving school with mathematics has been increasing, and certainly science and technology are sharing in the expansion of higher education. Perhaps Mr Crowne could give the A-level figures and Mr Hull the higher education figures.

(Mr Crowne) I think, Chairman, you will find the figures showing the numbers passing A-level and passing them with good grades have continued to

[**Mr Williams** *Contd*]
increase over the last fifteen years. I have some figures here for the percentages of 18 year olds achieving the various science subjects at A-level. It might help if I quote a few of them. In physics, in the 1978-79 academic year, 3.4 per cent of 18 year olds passed a physics A-level, and the figure for 1990-91 was 3.8 per cent. For biology it was 2.9 per cent increasing to 3.7 per cent. For chemistry it was 3.1 per cent increasing to 4 per cent. For mathematics it was 4.2 per cent increasing to 6.1 per cent.

Chairman

238. These are over the same time span?
(Mr Crowne) Yes.

239. Nearly 20 years?
(Mr Crowne) 1978-79 to 1990-91.

Mr Williams

240. I hope very much your figures are accurate, the impression I have is quite different, and I quote you an article from the *Times Educational Supplement* of August 1991 which claimed in its first paragraph that the number of students doing A-level science exams later that year had dropped, and physics and chemistry had fallen for the tenth year running.
(Mr Crowne) If I may say so, that is a direct function of the declining numbers in the age group. We are into a period of demographic decline for 16 to 19 year olds. I have quoted you the figures for the proportion of 18 year olds.

Chairman

241. Could I perhaps push the question of science teaching further? The Royal Society has taken a view about the importance of achieving double science, as it were, and they were pretty critical you did not have a reasonably high proportion actually doing double science. What is the proportion who take double science? Have you responded to the Royal Society's criticism on this matter?
(Mr Saville) We think it will be about 80 per cent taking double science, Chairman.

242. What is the anticipated target?
(Mr Saville) We do not have any formal target.

Mr Miller

243. 80 per cent of what?
(Mr Saville) 80 per cent of the age group.

244. Will be doing double science?
(Mr Saville) Yes.

Dr Bray

245. At A-level?
(Mr Saville) No, GCSE.

Mr Williams

246. I am delighted to hear that and it surprises me. By "double science" we mean 16 year olds spending 20 per cent of their time on science?
(Mr Saville) Yes.

Mr Williams: I am delighted to hear that. What I will say is that in the current generation of civil servants, as Dr Bray has referred to earlier, and politicians, the ignorance of science is quite incredible for the higher echelons of power. At my own school you either took maths, physics and chemistry or biology or it was general science, just one science subject, and this has led to the culture of arts or science and far too early specialisation. If you say the figure is 80 per cent, then that is a great triumph of the National Curriculum.

Mr Miller: Going on from the Royal Society's criticisms, they say, "It is particularly important that girls, who have traditionally been turned away from science, are not limited in their future career opportunities by being allowed to opt for the reduced science model without adequate thought." If I may indulge myself and consider the case of my own daughter who wants to do two foreign languages and mathematics but cannot, with that structure, do double science, what has gone wrong to constrain the curriculum in that way? Do you not think that some effort should be made to emphasise the increasing interest in languages, especially amongst people who have a science bent, and cannot something be done in your view to alleviate that? I think it does present a gender problem as well because there tends to be more emphasis on language skills among young girls than young boys.

Lynne Jones: What are the figures for boys and girls and what are the passes?

Chairman

247. If you have not got those figures with you, can you supply them?
(Mr Saville) The only figures for science that I have with me are for 1991, before of course the National Curriculum was being taught to pupils of that age. They do show a clear male-female bias in that, for example, about 70 per cent of those attempting GCSE in physics were boys, and only about 30 per cent were girls, whereas about 40 per cent of those attempting GCSE in biology were boys and 60 per cent were girls. One of the objects of the National Curriculum is to ensure that there is a balance of curriculum for boys and girls, and an insistence on science for all will take away some of that imbalance. The difficulty, as Mr Miller has pointed out, is when it comes to opting for single or double science and whether girls disproportionately will opt for single science, especially if the timetable in their school, in particular, constrains them if they want to do something like two modern languages and I agree that that is a problem. Ministers have already created greater flexibility in the last two years of secondary school by reducing the

[**Chairman** *Contd*]
constraints of the National Curriculum, allowing choices between history and geography, for example.

248. You will, I assume, be trying to monitor these trends in any event?
(Mr Saville) Yes, of course, but I think that the total load of key stage 4 is one of the things that we shall be looking at in the context of Sir Ron Dearing's review of the National Curriculum.

Lynne Jones

249. But those figures that you have given do not quite add up because you said 80 per cent. were doing double science——
(Mr Saville) Sorry, these figures, Chairman, were for GCSEs attempted in 1991. The figures I gave earlier were for people who had embarked on National Curriculum courses in 1992 and who will not be tested, therefore, until 1994.

250. So that would indicate a big jump in those taking science?
(Mr Saville) Yes, indeed.

Dr Bray

251. Before we leave this subject, in biology, in terms of practical skills (I am not up with the position in England, but in Scotland I am well aware of the situation) how much work is done on actual dissection? I understand the objection to experiment with frogs' legs, things like that, but what about the dissection of the sheeps' hearts and the cows' eyes that used to go on?
(Mr Saville) I have no figures on that, Chairman. I think one thing I can say is that because of the sort of worries there have been about BSE and the dissection of things like cows' eyes has almost disappeared from schools because people do not want to dissect organs that have some connection with the cortex.

252. What about sheeps' hearts?
(Mr Saville) I do not know, I am afraid, Chairman.

253. Is not the fact of the matter that there is great unfamiliarity of the young with actual biological experiments and systems nowadays because of the fear of the animal rights' lobbies?
(Mr Saville) I do not know about the animal rights lobby. In general, the National Curriculum in science has a very heavy element of practical application in it, so that it is concerned not just with teaching by rote but with ensuring that pupils do have laboratory skills and are able actually to conduct an experiment, and that is one of the most demanding parts of the curriculum.
Dr Bray: I think you will find physiologists are very worried about the lack of laboratory experience.

Chairman

254. As far as you are answering Dr Bray's question, there is not a restraint that you are aware of that will prevent, as it were, biological experimentation on the safe organs taking place?
(Mr Saville) No restraint at all, Chairman. The practical aspects of all the science subjects are encouraged.

Mr Batiste

255. I understood you to say earlier that the proportion of young people studying for science A-level had increased. That is correct?
(Mr Saville) Yes, that is correct.

256. If that is right, why is it that I hear so often from universities that the entry requirements are significantly lower for students wanting to read science and engineering courses than they are for arts courses?
(Mr Dawe) I think there is a distinction here between science and engineering. I think that comment would not really apply to entry to science courses at university. It certainly does apply to engineering where there have been comments from universities that they cannot get the A-level standards they would like to see. We hope that again promoting vocational qualifications—and something like 20 per cent. of engineering students now come up the vocational route, between 16 and 18—will actually improve that position. I think there is a job to be done in further education colleges and sixth form colleges and, indeed, in the engineering industry selling its own image actually as a good place to work. There is an important distinction to draw between science and engineering entry.

Chairman

257. Could I ask a general question about teacher supply that is quite often hotly debated. Are you confident the supply of teachers will not decline as economic recovery slowly progresses?
(Mr Saville) Chairman, putting it the other way round, it is certainly the case that we very much benefited from the recession in improving the supply of teachers. One has to hope that the messages of this period about teaching being a satisfying and rewarding profession will have got through and that that supply will be maintained. One of the factors, of course, will be that the more that schools succeed in carrying people through with science and technology throughout their school careers, the more people will be inclined to qualify in these subjects and increase the pool of potential science and technology teachers.

258. You will, of course, be involved in the new initiative on teacher training which would bring a lot more back to the schools, I understand. Is that going to be easily accomplished? Are you going to have enough resources? Are schools willing to undertake this kind of work?

[**Chairman** *Contd*]

(Mr Saville) It is not a subject in which I am an expert, Chairman, but I think that the initial responses from schools to the invitation to take part in teacher training have been very encouraging and the first list of schools that are going to do it was announced recently.

Mr Williams

259. Just a brief point here on teacher supply. There used to be a problem for mathematics, particularly of it being taught by non-mathematicians, especially at lower secondary school and the problems there more generally in science being taught by non-qualified or poorly qualified scientists or somebody that was very much a second-string science teacher. Has the recession meant that within the school staffing, within the organisation of the school, the shortage has been taken up by substitution? My related point is, if you say that the National Curriculum has been sufficiently successful for 80 per cent. of our 16-year olds following the double science, surely that would have created a teacher shortage in those areas?

(Mr Saville) It will certainly create a pressure for more teachers in those areas, Chairman. I am afraid I do not have the figures for mathematics with me.

Chairman

260. Perhaps you could drop a note to the Committee Clerk on that?

(Mr Saville) Yes.[1] Certainly, in science things are really very healthy now. The proportion of teaching being provided by teachers without a post A-level qualification in the subject, in subjects like chemistry and physics, has fallen so that now, for example, 97 per cent. of chemistry teaching is provided by teachers with a qualification in chemistry and 96 per cent. of physics teaching. That is the 1992 Staffing Survey.

Mr Williams: What about the problem within the double science of physics, chemistry and biology, the physicists needing to teach some of the chemistry units or biology units; has that been a problem or is it resolved?

(Mr Saville) It has obviously been a problem for some teachers, but where teachers who have a degree in one subject nevertheless have A-levels in other subjects, they are very often able to make the jump with no very great difficulty and we have invested a great deal of effort in in-service training to allow teachers to bring themselves up to speed across the whole range of the science curriculum.

Chairman: Can we now turn to General National Vocational Qualifications.

Cheryl Gillian

261. I am quite interested in this new system. My education was 20 years' ago like other people here and it is a very new area and I see in your paper you give us the different levels and what they are supposed to be roughly equivalent to, but it does seem that there is very little availability for NVQs in schools and I guess most of the young people going in for NVQs are those that are doing youth training and that kind of thing. Can you comment on the success of the NVQ system? How many young people who embark on them are actually successfully getting qualifications? How many are going on to higher levels and also can you comment on the parity of esteem between the O-level system and NVQs. Would there not be pressure on young people in schools to actually go down the A-level route because that is seen as having greater esteem and being more likely to be recognised by higher educational establishments. Can you also comment on the system that we have in this country now and similar systems in other countries in Europe?

(Mr Dawe) If I may start by giving a bit of background to that and perhaps Mr Crowne can supplement it by saying exactly where we are on NVQs. The background is there have always been qualifications like BTECs, RSAs and City and Guilds for many years. In the late 1980s there was a review that looked at the whole area of vocational qualifications and I think rightly decided it was just too confusing a scene. There were about 170 awarding bodies and the whole thing needed to be rationalised and that was the origin of National Vocational Qualifications. We aimed at people who had already left school—young people on the Youth Training Scheme or adults in employment—so that was the origin of national vocational qualifications which began some years ago. However that did not cover people in full-time education and therefore we have got to draw up a parallel route for people in full-time education particularly between the ages of 16 and 18—although it might be available for other ages—which could give a broad base of general vocational qualifications. We then would have three streams, if you like, for 16 to 18 year olds: an academic stream reaching A-level; national vocational qualifications for those on Youth Training arrangements who had left school or college; and then for full-time education the General National Vocational Qualifications which have only recently been launched. NVQ, level 3, and GNVQ, level 3, are equivalent to A-levels broadly but the GNVQ is very new. Mr Crowne is our expert on this subject and could perhaps add a few words.

(Mr Crowne) Can I just say, Chairman, we are currently in the first year, the pilot year, of GNVQs. There are five subjects being piloted in around 100 schools and colleges and indeed the week before last we had the first GNVQ awards at level 2 which is the GCSE equivalent level. From this September those five subjects will be very much more widely available in, we estimate around 1,000 schools and colleges. The Secretary of State recently invited the National Council for Vocational Qualifications to aim to set up a pretty comprehensive framework of GNVQs over the next two or three years and that is on the basis of early feedback from these courses which shows they are really going very well. They have

[1] See page 65.

[Cheryl Gillian *Contd*]

been very well received by students and by schools and by colleges. I would stress we are still at the early stages of this and as with any new qualifications system, it will take a little while to bed down but I may stress that the feedback from inspection and other kinds of evidence really shows they are going rather well. To complete the picture, we have had the first awards two year courses at about GCSE level and at the end of the next academic year we will see the first awards for level 3, which is the equivalent of A-level, and we will then hopefully see some of those students go on to higher education on the basis of their GNVQ achievements.

Lynne Jones

262. Why are they not integrated into the A-level system?

(Mr Dawe) In effect, as Mr Crowne has just been saying, there is a straight read across into the A-level system in terms of the level of qualifications. There is going to be a major requirement to promote and we are starting to promote these qualifications both to the gatekeepers of higher education and to employers and the fact that they are equivalent. The courses themselves, of course, are rather different from A-levels. They involve typically about 12 different modules with numeracy and communication built in along with occupational skills. A lot of the testing is done through course work, for example, rather than written tests. So it is a rather different approach but we regard the levels as equivalent to A-level for the level 3.

263. Why not integrate with A-levels if they are equivalent?

(Mr Dawe) An interesting idea.

Chairman

264. What in actual fact will by covered by a GNVQ in manufacturing?

(Mr Dawe) Perhaps again if I ask Mr Crowne to go through the modules.

(Mr Crowne) I will not go into great detail because it is characteristic of GNVQs that they are specified in very great detail, module by module; but basically the structure of the qualifications is that at the A-level equivalent there are a total of eight mandatory units which will be concerned with the essential knowledge skills and understanding required to operate at the appropriate level in a job in a specific area of employment, in this case manufacturing. Now the modules are specified on the basis of identifying clearly distinguishable aspects of performance required to do those jobs. So you will have modules concerned with manufacturing processes, the underpinning technology and applying knowledge about the processes to specific problems in the industry. The aim is to support a very largely project based approach to teaching and also to encourage team-working and problem-solving on a team basis.

265. It is not related to an individual manufacturing process, textiles for example?

(Mr Dawe) It aims both to provide a broad grounding in issues common to the manufacturing industry but then enable individuals to focus in their project work on specific problems and specific circumstances of particular manufacturing industries, if you like they would be required to look at a specific industry as part of the GNVQ award.

Cheryl Gillan

266. I see in the paper that we had given to us that the first GNVQ currently available did not include science and engineering and that science and engineering is currently being developed. I wonder if you could answer why the priorities were set up in the way that they were on these qualifications and when we can expect the GNVQ in science and engineering to be available in what sort of timescale?

(Mr Crowne) Certainly, Chairman. I would say that these first five qualifications have been developed against a very tight timescale and the main basis for selecting those titles was the judgement of what areas were most likely to produce acceptable qualifications in a short time. In other words the issues that needed to be addressed have been very thoroughly explored in previous qualifications and we are building very substantially on what had gone before. It was always recognised that science and technology and engineering would be an important feature of GNVQs but at the same time it was felt the issues were a bit more difficult and required a little bit more time to investigate and the decision was taken that these GNVQs should come along a little later. I would stress "a little later". We are talking about their introduction over a two or three year period which for a new qualification system is very demanding.

Chairman

267. The whole of the pattern of the GNVQs will be established through the school system in two or three years.

(Mr Crowne) After two or three years we will have a broad range of GNVQs titles which will cover most areas of employment. I would stress these are broad, these are general vocational qualifications.

Lynne Jones

268. Why were they developed over a very tight timescale? One of the criticisms we have had is we have developed various qualifications and they have then been abandoned which then left the people studying for them stranded. It is very worrying that we are developing new qualifications under a very tight timescale.

(Mr Dawe) As Mr Crowne said, we are building on BTEC qualifications, for example, which are already there. We are not starting absolutely from scratch and I think there would be no question of abandoning these qualifications. What we are trying

[**Lynne Jones** *Contd*]

to do essentially is classify and standardise qualifications at a vocational level right across the board so they are more understandable to people. The problem at the moment is there are so many qualifications and that it is confusing for employers, parents and young people and we are tying to get out of that jungle into something much simpler. I think my main answer to your question would be that I would be worried if we were starting from scratch, but we are building on some pretty well founded qualifications like BTEC, like City and Guilds, which we have had for many years, and I think it will last.

269. Just a simple supplementary question, it says more are being developed, including science and engineering. Is there going to be a GNVQ called science and engineering or does that mean there are going to be individual qualifications broken down into more areas of science and engineering?

(Mr Crowne) There is certainly intended to be a GNVQ in science and the Secretary of State is currently considering a report from the NCVQ on that possibility. We do not yet know the ultimate list of GNVQ titles. I think in a sense we want to listen to the market. It may be that what young people want to study or would prefer to study in GNVQs is rather different from our original conception, so I think we have to listen rather carefully to the feedback we get. What we are concerned to do, as Mr Dawe has already mentioned, is to create a system that is relatively simple to understand and I think we have to guard against a proliferation of qualifications. That has often been a criticism of our past. What we want to do is create a system that is relatively easy to understand and the connections between the qualifications also relatively easy to understand. I think our present Ministers envisage perhaps 12 to 15 different GNVQ titles, but we would not like that to be regarded as holy writ. We will just have to wait and see how the market develops.

Chairman: Let us turn to proliferation in another area.

Mr Miller

270. The Secretary of State in his recent disagreements with the teaching profession has placed great emphasis on measures of quality, standards and so on and so forth and, indeed, Mr Dawe, you said yourself that one of the difficulties is the proliferation of some of the organisations that are supposed to be responsible for measuring standards and, of course, the LEAs, the Funding Councils, the TECs, the NCVQ, OFSTED, all of these bodies. The Secretary of State has recently announced the merging of NCC and SEAC to create the new body SCAA. This presumably is designed to simplify the structures and take a step towards the criticism that I think you recognised yourself. Are there any further changes planned? If so, are you in a position to tell us on what scale? Do you accept the idea that the smaller number that were created, the more it would actually improve the comparisons between the various systems?

(Mr Dawe) I think we have made progress in that direction. As you have said, SEAC and the National Curriculum Council being merged will mean there is one body dealing with curriculum and assessment matters for schools. At further education level, of course, now we have a single Further Education Funding Council, so there is one body, if you like, leading that sector, dealing with all the colleges across the country and, of course, at higher level we have merged the Universities Funding Council and the Polytechnics Funding Council, with the ending of the binary line, into the Higher Education Funding Council. So I think for the schools we have got the new SCAA, for further education the Further Education Funding Council and for higher education the Higher Education Funding Council. I do not myself, certainly in the short-term, see any prospect of further mergers in those areas.

271. Given your response to Dr Jones, how do you see the TECs fitting into this?

(Mr Dawe) I had quite a lot to do with TECs because I was Head of the Training Directorate in the Department of Employment when they were being set up and I moved across to deal with further and higher education, perhaps not entirely by accident, I suspect. I think they have a very important role to play. What are TECs? They are essentially employer-led bodies at local level. They are in a very good position to specify employer requirements in terms of skills and what they want to get out of the education and training system. So already TECs are very much engaged in partnerships with schools, in links with colleges and with their local higher education providers. Perhaps where there is the closest link is we have got TEC representatives on college governing bodies, on the regional committees for the Further Education Funding Council and on the Further Education Funding Council itself. I do not see that as causing duplication. I see TECs as giving a new coherence, if you like, to the voice of employers at local level on what skills they want and what they want out of the education and training system. I see colleges and higher education responding to those needs.

Chairman

272. Can I turn to higher education. The Department has published a number of objectives for higher education, such as record levels of participation, higher education maintains its high quality, it makes suitable arrangements for student support. What is the position on research and the relative priorities for those objectives? You are talking about participation to encouraging "research which leads to development and application." What does that mean exactly?

(Mr Hull) I think our priorities on research are reflected in the recent White Paper on science and

[**Chairman** *Contd*]
technology where we are encouraging the universities to contribute to wealth creation. The priorities of our own Department and its funding are mainly related to basic and strategic research because of the balance of responsibilities described in the White Paper. The other Departments have their main objectives in relation to applied research.

273. So you would feel that the emphasis in the newly published White Paper will make a positive difference, will it, to what you were asking universities to do?
(Mr Hull) In relation to our funding, we would expect the Higher Education Funding Council, in the way that it distributes its funds for research, to take account of the priorities reflected in the White Paper. Equally, we would be expecting the research councils whose funding is more specific for particular projects also to reflect the priorities in the White Paper.

274. How are you going to ensure that? HEFCs do the funding, but how are you going to ensure these aims are in fact met?
(Mr Dawe) That would be for the HEFCs to pursue with the higher education institutions. It is proposed, too, that there should be a group for involving the Office of Science and Technology, ourselves and the Funding Councils to look right across the board to make sure these priorities are being carried through, but it would then be for the HEFCs, of course, to allocate money to individual universities and to monitor the progress.

Dr Bray

275. Are you not putting any money in to applied research, severely practical research in the ex-polytechnics?
(Mr Dawe) There is a lot of research of that kind in the ex-polytechnics. It is mainly financed by employers and that quantity of research has increased about fourfold in the last eight or nine years, so there is very substantial applied research in progress.

276. Does it not need and deserve substantial support from your Department and the Funding Council?
(Mr Hull) The White Paper discusses the definition of near market research which has a customer in industry or whoever. It should be carried out by universities or by the science base on a self-funded basis. So the priority for public funds must be for non-near market research, but there are types of applied research which do need to be funded publicly. Indeed both the research councils and funding councils recognise that.

277. There is also the very important applied research which is an essential part of actually teaching practical experience for the students.
(Mr Dawe) Yes, indeed.

278. That has to be funded.
(Mr Dawe) We would accept that. The research does go very closely together with the teaching and that is one of the reasons why the White Paper confirms what is known as "dual funding", that the HEFCs will continue to allocate research money along with the teaching money to the institutions. There is a very important link there.

Mr Williams

279. I cannot help but feel that links with industry and the application (and a main subject area of our inquiry is the links between the science base and innovative and competitive technology) in a sense are quite low in your list of priorities. In terms of science and universities you are looking to first degree knowledge education and then research work is really academic. My own course many years ago, Chemistry at Oxford, for six years I found quite fascinating in an academic sense but industry was just never mentioned at all and in a sense it encouraged an attitude of something like contempt for the application of science. I regret to have to say that. I enjoyed the course in a purely academic way, it was good learning and gave an appetite for more knowledge but there was nothing said in terms of its application. Now I took it at that time that applied science was for polytechnics and "lower beings", as it were. It was quite appallingly elitist in that sense but that was Oxford and chemistry in the 1960s I dare say. I cannot help but feel the same attitude prevails today in terms of industrial application, in terms of wealth creation and applying our great discoveries to useful inventions and that is at the root of our malaise.
(Mr Dawe) I think times may have changed somewhat since your Oxford time in higher education. Employers are represented at every level of the system. They are on the Higher Education Funding Council and on the governing bodies of universities and again increasingly TECs are getting involved with their local higher education providers. I think that it is still fair to say that some of the new universities, that is the old polytechnics, have got the closest links with employers but I think it has spread more extensively through the system. We ourselves in the Department have been encouraging the Funding Council, for example, to give greater priority to two year diplomas which are very much linked to local employment needs and the Department of Employment, which I think you are seeing separately, although it started in my time there, have launched the Enterprise in Higher Education Programme which is aiming to get academic provision more geared to the needs of the economy and of employment.

280. Do you not think we need a new infrastructure somewhere between research work at universities and for higher education and industry. In a sense the links are rather haphazard and rather amateur. I was quite impressed in our visit a couple of months ago to Germany where were visited Frauhofer institutions at the university level,

[**Mr Williams** *Contd*]

Steinbeis institutions at the level of higher education and Max Planck institutes for academic research but really again there are good links with employers. I must say, comparing that with the British structure our research work (and that covers your responsibility for higher education) is of a very high quality academically and compares well with the whole of the rest of the world but in terms of its application it is at a very amateur kind of level and it is very haphazard. It is just a guess but should there not be some kind of middle tier, some kind of infrastructure there that blends problems in industry and placements from university?

(Mr Dawe) I am not sure I would want to introduce a new tier, as it were. I think what would be a better way forward is to build on what is already happening in terms of employers and universities getting closer together. I do genuinely believe they are getting closer together. I think the advent of the polys has made a major difference to the sector and they are now fully in the sector as universities and I think that has also affected other higher education institutions. I think things are going in the right direction. I would want to build on those links and I think the focus should be on doing that rather than doing something completely new and different which I think could cause more problems than it is worth.

281. I do not know very much about other things like innovation centres or Faraday centres but is there something within the formula that would help to take the results of research and convert them more easily to market?

(Mr Dawe) I think again the OST have been looking at this. It may be worth raising it with them but for the reasons I have given I would have my doubts. I think experimentation is always quite welcome.

Chairman: I think you have already demonstrated in previous answers the scale of investment by manufacturing companies in polytechnics. That is certainly happening and a good thing too. Lynne Jones.

Lynne Jones

282. You are encouraging more young people to go into science and engineering and technology and also you mentioned two year diploma courses and you have also taken various actions to encourage the universities to do this in terms of the fees that are applied for different types of students. On what objective basis have you actually come to this conclusion? Obviously you have got links with employers but employers cover a multitude of sins. How are you actually analysing the needs of industry and of employers and coming to those kind of conclusion? Also one of your objectives is to maintain the quality of higher education and yet we are now hearing of many universities talking about how to charge fees because of the inadequacy of their funding and financial situation which has declined.

(Mr Dawe) On where do we think the skills will be needed I think it is a mistake to be too specific that we need X chemists and Y biologists. What we can see (and we look at the labour market analysis and projections) is the demand for skills increasing at a higher level and stories about shortages of scientists and engineers so we try through financial incentives to increase supply. We do not control or manage the academic system and we must remember the academic freedom of universities. We can seek to steer the system in one way or another and we thought it right to do that in the last year when we sought to widen the gap between the fees for science and technology and for other courses. We get the information, as I said, from the labour market analysis and projections although we try not to be too detailed about that. On quality there has been this enormous expansion of higher education over the last five years but if you look at the results that students achieve at universities there is no sign from that of any falling off in quality. There are certainly stories about pressures on premises and capital and so on but in terms of the results of people passing through the system, degree levels and so on, quality seems to be maintained and the top up fee mentioned is just one particular institution flying a kite on that subject.

283. Are you sure of that? I have heard this before about results being the same but if you talk to people in universities they do feel the pressure is on them to lower standards such that a student getting a degree at a particular level now is perhaps not the same as that level a few years ago.

(Mr Dawe) I do not think I would agree with that and I myself have not heard universities saying that. There are not a lot of people who would say that their degree levels have actually slipped. What some will say is that the quality of life for the student during the three years at university has.

284. Is there any outside analysis being done on this because obviously it is done, it is internal decision-making with some external checks within the same system, and if there is a steady drift downwards it would be very difficult to detect it.

(Mr Dawe) Yes. As you say, the safeguard essentially is the external examiners system.

285. But they are from another university and they are all doing the same thing perhaps.

(Mr Dawe) If you believe there is some conspiracy between universities——

286. No, no.

(Mr Dawe) I am not sure that Oxford and Cambridge would accept the Department going in to monitor their standards of degrees.

Mr Batiste

287. Could we just take it the other way? We do get, for example, in relation to engineering (this follows up from the answer to the previous question)

[**Mr Batiste** *Contd*]

lower demands made by the universities to admit students into engineering and with lower grades at A-levels. A first year is in some respects a remedial year in which you bring the students up to the level they should have been at before they get to university and then the second two years are very much under pressure leading to extended pressure for an additional year on the courses. I would imagine against that background some slippage in the stringency of the quality of the course would be almost an inevitable consequence?

(Mr Dawe) If I may, Chairman, the point about engineering, as we were discussing earlier, is the quality of the intake. The answer to the question about the quality of the whole university process, is in the output, in terms of degrees at the end of the system. Engineering, I think, is a very special case that we do need to look at in terms of how can we increase the quality of the input, the quality of the young people moving into higher education.

288. So you are accepting then that there has been some slippage in the standards of engineering degrees?

(Mr Dawe) As I said earlier, in terms of the entrants to engineering, I think universities and we would like to see a rise in the number of well qualified A-level people.

289. Has there been a decline in the number of Firsts and 2:1s in engineering or is it in proportion to the number of students going to university over the last five years?

(Mr Dawe) I myself do not have that figure for engineering. We could check that.

Chairman

290. Could you check that out and let us have a note from you on that?

(Mr Dawe) Yes, certainly.[1]

Dr Bray

291. It is not just engineering, is it? A fourth year has been agreed for physics at Imperial College.

(Mr Dawe) There have been some cases outside engineering of a movement to four years.

292. If that was necessary to maintain standards in prestigious institutions such as Imperial College, then what has happened——

(Mr Hull) The case being made about those courses was not about the quality of inputs and, indeed, our Secretary of State said publicly that he would not encourage the extension of courses in universities simply to deal with remedial problems. The argument, as I understand it, in physics and some other science subjects has been about the amount of course content needed to cover the whole breadth of the subject given that the body of knowledge has expanded.

[1]See page 65.

Chairman: It has been pretty good for physicists over the years, has it not? They have done terribly well in noble science and Nobel science as well.

Dr Bray

293. It has been pushed on beyond the graduate level. You are now wanting to have the first year of a doctorate taught overseas.

(Mr Dawe) As Mr Hull has made clear, our Secretary of State is not keen to see an extension in the length of university courses. I think with any given kitty of money (and we are always going to have a given kitty of money) any increase in the length of the courses is bound to be at the expense of other people getting into the system at all.

Chairman

294. And a consequence on supply?

(Mr Dawe) Exactly.

Dr Bray

295. There are the slippages there. The taught course of an MSc used to be done in the third year of the highest ranking science departments; it has now slipped into the MSc.

(Mr Dawe) I think, as Mr Hull has said, the physicists themselves would argue that there is, as it were, more to be taught.

Chairman

296. The syllabus now justifies a fourth year?

(Mr Dawe) Exactly.

(Mr Hull) I think it is also worth saying that the policy about post- graduate courses that Dr Bray has referred to is about making the taught masters the normal pre-requisite for research training. It is more about the nature of the PhD than about the claimed inadequacies of previous studies. It is about research training rather than about First degrees.

297. Can I ask a question about industry and your contacts. You have a responsibility to discuss the role of the Department as a provider of graduates within industry. What sort of contact do you have? What form do they take? Do you meet regularly to discuss the needs in the market?

(Mr Dawe) As I say, the Higher Education Funding Council itself meets monthly and employers are represented on the council and I sit on the council as an assessor from the Department. We have had regular meetings over the last year with TECs. We have been working around the country meeting about one region per month. Again, we are picking up messages from employers and, of course, we have regular contacts with the CBI who pass on views about employer need. So there are a whole range of contacts, both geographical with TECs and at the centre with the CBI and other organisations. For example, in engineering where we have been trying to address some of the issues that have been

[**Chairman** *Contd*]
raised, we have had discussions over the last year with the Engineering Council, with various engineering institutes, and with the Engineering Employers Federation.

Mr Miller

298. Moving on to course content, and you touched on it slightly, ACOST reports suggest that increasing emphasis be placed on the teaching of particular areas. For example, there is the Report on Cleaner Technology and it was suggested that it ought to be incorporated into science and engineering courses at all UK universities. What is the Department's view of such proposals? What mechanisms exist for implementing them? For example, just to take that specific one which clearly cuts across functions of the Department of Environment, the DTI, the Department of Health, and S&T; what actually happens in evaluating proposals like that and determining whether something should be fed downstream into the universities?

(Mr Dawe) I think the essential point here is that those messages have to be fed direct through to the universities because we in the Department have no standing and cannot have any standing on details of course content.

299. But you would advise, presumably?

(Mr Dawe) We could advise on issues through the Funding Council——

300. With such a broad sweeping statement, "This should be incorporated in all science and engineering courses", surely the Department would express an opinion? It must evaluate the advice, first of all.

(Mr Dawe) We could promote a general message. We could not dictate to individual institutions in higher education that they ought to amend their course content in particular directions.

301. How would that comment from, say, a body like ACOST be evaluated within the Department?

(Mr Dawe) You mean in terms of transmitting it on to the higher education world?

302. How would you determine whether it was the right message that you wanted to pass on to the higher education world?

(Mr Dawe) I do not think it would be——

303. I will be very blunt about it, it comes back to the earlier comment that one of my colleagues made about your own professional background and I do not hold that in any disdain, but how precisely do you determine the value of such advice from bodies of that kind of repute?

(Mr Dawe) I think for the reasons you give I would not put, as it were, ourselves between ACOST and the universities because I do not think that is our role. If there are issues to which Ministers attach particular importance, we would want to ensure that they were brought to the attention of universities, but for us to sit in judgement on ACOST proposals, who are in a much better position than we are to know the importance of particular issues, I think that would be wrong.

Chairman

304. But ACOST is a well established advisory council and presumably any report that they would wish to make Ministers would take seriously?

(Mr Dawe) Yes.

Lynne Jones

305. If they were commenting on the National Curriculum which does have a responsibility and a direct impact, for instance, on schools, how do you deal with that? What worries me about all these various bodies involved in our educational processes now is that too many cooks spoil the broth. We know, for instance, that the Department for Education cannot gets its act together with the Scottish Office in relation to testing so how can we have confidence in all these other areas?

(Mr Dawe) There is an important distinction to be drawn between the National Curriculum for schools where the Department has a major say and the content of university courses where we have virtually no say. In terms of how we would take account of views on the National Curriculum, perhaps Mr Saville would like to comment.

Chairman

306. Let us point to a specific case, Mr Dawe. The White Paper says in future a Masters degree would be the normal route to further post graduate training. Does this imply that the Department looks favourably on broadening the scope of first degrees?

(Mr Hull) The first point to make on that is that the primary instruments for pursuing that policy will be the research councils through the Office of Science and Technology. As far as we are concerned I think we would expect the Higher Education Funding Council to take account of the policies declared in the White Paper in its decisions about future funding of post graduate training.

307. That includes the HEFC—they would be primarily responsible?

(Mr Dawe) Yes.

Mr Miller

308. Chairman, can we push a little bit further on this question of how things are evaluated within the Department. I take the point that if it is a matter for the universities you pass it over to the universities but in the context of areas which are clearly your responsibility, say the secondary school curriculum, if a report was produced (indeed we spoke earlier on to about the National Institute report) how do you

[**Mr Miller** *Contd*]

in practical terms go about evaluating the importance of such a report when it covers areas of science and technology where there is little professional expertise in the Department?

(Mr Saville) In terms of the handling of the National Curriculum, Chairman, the primary responsibility for advising the Secretary of State rests not within the Department but within the National Curriculum Council and in future with the SCAA and they, of course, have a lot of professional expertise both on their staff and through people representing the full range of educational interests in membership of the bodies. Ministers would look to them on the one hand and on the other to OFSTED for advice on the practical impact on the schools based on inspection evidence so there are sources of advice for Ministers which do have the kind of expertise in science and technology which quite rightly you say we lack.

309. So it is not your function?

(Mr Saville) Our function, I suppose, is to make sure that that process of advising Ministers from the bodies that have been set up statutorily to advise them goes on in an orderly and effective way.

310. Would that be different if it was an area that you had special academic skills in? I do not know what your own background is but if it was a part of the curriculum where you have got specialist personal knowledge because of your educational training——

(Mr Saville) I think one has to be particularly careful in a sense not to get seduced by that. I read English but I read English 25 or 30 years ago and I would hesitate now to call myself an expert in English. The fact that that was my degree a long time ago is not really very relevant. What you want is the ability to advise seriously in relation to what is currently happening in schools.

(Mr Dawe) I think our general reply is that we think it is right to rely on the expertise rather than to set up a Department for Education full of experts on every subject under the sun.

Chairman: A little modesty is an excellent policy. This is a question that does relate to problems that occur from time to time anyway—young people dropping out of science. What steps are being taken to ensure that the efforts made to prevent young people from giving up science at too young an age are not thwarted by university entrance requirements, for example.

(Mr Dawe) I suppose again one could take this at different levels. The National Curriculum will for the first time require people to keep going until the age of 16 in science. Then we come to the further education sector and we have had a problem of dropping out particularly at the age of 17. There was a recent report on this from the Audit Commission. What we have done on that is take it up with the Higher Education Funding Council who have now written to every college in the country drawing attention to this problem, seeking solutions and getting it high on their agenda. I think one of the key requirements for the system is to tackle this problem of drop outs between 16 and 18. The 16 year old figures are very good, much better than they used to be but we are still losing too many people before they get qualifications at the age of 18 so that is a major area to be tackled. At university level our drop out rate is one of the lowest in the world in higher education. The bigger problem is in further education and that does need to be addressed.

Mr Williams: Can I come in specifically on 16 to 18 year olds. I would like to take the numbers for 80 per cent of 16 year olds doing double science. We have got a problem going into A-levels, 3 A-levels from eight O-levels. Is there not an argument for five A-levels spread over five years, including one in science and one in the arts? This country is quite exceptional at having this remarkable restriction at the age of 16.

Chairman

311. That opens a very substantial subject.

(Mr Dawe) Shall I attempt to answer briefly? I think we see an alternative course to that of the widening of A-levels through the establishment of general vocational qualifications. Ministers see A-levels as very popular and effective and we have said earlier how effective they are in terms of feeding into higher education. They do not want to change that system but build up alongside it the broader based GNVQs which will give opportunities for young people who are not suitable for that narrow range of A-levels to broaden out through the General National Vocational Qualifications. In addition we have AS levels—two AS-levels are equivalent to one A-level—which also gives the opportunity to young people of taking six subjects instead of three.

312. In view of your responsibly would you not rather have had the chance to do science until the age of 18 in a wider sense?

(Mr Dawe) That is a personal rather than a Government question. I am not so sure my life would have been different.

Chairman: I do not think you need make an opinion on that.

Mr Batiste

313. Can I go back to this drop out rate. You said that we had one of the lowest drop out rates——

(Mr Dawe) From higher education.

314. From higher education, that is right. Would you say that is a by-product of the responsiveness of the system to the students that were studying or the fact that we still did not have a high enough participation rate so as the participation rate rises so will the drop out rate increase?

(Mr Hull) I think it is mainly a feature of our selective system of university entry whereby universities only take students who they believe they

[Mr Batiste *Contd*]

can bring to the level of qualification that the course requires. The history of the last few years when we have experienced participation rate expansion has been that that has not been at the expense of drop out rates according to the latest statistics we have. I think that as long as we experience increasing participation in the 16 to 18 year age group, as long as more students are coming up to the A-level standard or the vocational equivalent, we should see a continuation of a selective higher education system which is taking students who still are capable of getting through to the qualifications.

Dr Bray

315. To maintain that and increase the participation, is it not sensible to lead the remedial training from entry into university on to the further education system?

(Mr Dawe) Yes I think there is much in that. As Mr Hull has said, we have actually doubled the participation rate in the last five years without any significant effect on drop outs but you are right, many higher education institutions are now working very closely with the further education world in the sense of having access courses in further education, in having a foundation year in further education so that link is getting much closer and I think it is helpful to address problems that may arise further on.

316. Should this not be used in particular to widen the basis for recruitment into Oxford and Cambridge?

(Mr Dawe) I am not sure that Oxford and Cambridge would find it necessary to have access courses. They seem to recruit very well without them.

317. But not from the state schools?

(Mr Dawe) A rising proportion of Oxbridge entrants now come from the state side.

Dr Bray: But it has been rising at a snail's pace for the last 50 years and is still wildly disproportionate to the numbers in the country. Can I ask, the proportion of students gaining entry to Oxford and Cambridge from public schools, that is, private schools, is far higher than the proportion of children of that age group in those schools?

(Mr Dawe) That would certainly be correct.

Chairman

318. Mr Dawe, Mr Saville, Mr Crowne, Mr Hull, thank you very much indeed for being here so long and for answering our questions. We are very much obliged.

(Mr Dawe) Thank you, Chairman.

Further submission from the DFE following the oral evidence (1 July 1992)

Thank you for your letter of 22 June requesting further written evidence in response to the two points arising from oral evidence taken by the Committee from DFE officials on 9 June. The Committee's questions and our replies are as follows:

Q259: The Committee would like to have information on the proportion of mathematics teaching provided by non-mathematicians. They would also like to know what effect the introduction of double science, and the resulting increase in numbers taking science, has had on the requirement for science teachers.

DFE RESPONSE

Science

1. Science under the National Curriculum became compulsory at Key Stage 4 (years 10 and 11) only from the autumn term of 1992. Because the Secondary School Staffing Survey is not conducted annually, the only indicator we have of the impact of the introduction of National Curriculum science on the demand for and supply of science teachers is the January 1993 teacher vacancy survey, which actually shows a fall in the number and proportion of reported vacancies for science teachers from 91 (or 0.3 per cent) to 56 (or 0.2 per cent), as compared with vacancy rates for all subjects of 0.5 per cent and 0.3 per cent respectively. There is therefore no evidence that the supply of science teachers is not able to respond to the demands so far created by the National Curriculum. This will in part be because even before the introduction of National Curriculum science at Key Stage 4 some 68 per cent of pupils were already taking science as a double subject, while the remainder were taking science as a single subject or various combinations of the three separate sciences. The gap to be bridged was not therefore as great as might have been thought. In addition, the supply position has been improved by recent increases in the numbers of entrants to science initial teacher training courses; these have gone up by more than 50 per cent since 1990.

Mathematics

The 1992 Secondary Staffing Survey suggests that 10 per cent of all maths tuition in secondary schools is provided by teachers without a post-A-level qualification in the subject. The distribution is weighted slightly towards the early years of secondary school (years 7-9) where the proportion of such teaching is 11 per cent, as compared with 6 per cent in years 10 and 11.

Q289-290: The Committee has asked for figures showing the number of firsts and 2:1s in engineering awarded over the last five years, given both absolutely and as a proportion of those sitting finals in engineering.

DFE RESPONSE

The attached table shows the numbers and proportion of engineering graduates obtaining a first or upper second in the last five years (six years for universities formerly funded by the UGC/UFC).

Please let me know if your require any further information.

July 1993

Degree class distribution of university graduates in engineering 1987-91

	1986	1987	1988	1989	1990	1991
UK graduates in engineering from UK universities funded by the UGC/UFC						
No. obtaining 1 or 2:1	3,157	3,175	3,311	3,481	3,693	3,501
Per cent obtaining 1 or 2:1	43	43	45	45	47	46
Total engineering graduates	7,310	7,359	7,430	7,755	7,922	7,607
UK graduates in engineering from former polytechnics in England and Wales	Old subject classification			New subject classification		
No. obtaining 1 or 2:1	1,256	1,381	1,565	1,260	1,394	n/a
Per cent obtaining 1 or 2:1	30	29	32	38	38	n/a
Total engineering graduates	4,126	4,741	4,841	3,339	3,639	n/a

Note: There is a discontinuity in the series for polytechnics because a new system of subject classification was introduced in 1989.

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